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# **INTELLIGENT TRANSPORTATION SYSTEMS:**

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## **Critical Standards**



**U.S. Department of Transportation  
June 1999**

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## ***Message from the Secretary***

We are pleased to provide the report, *Intelligent Transportation Systems: Critical Standards*, as required by the Transportation Equity Act for the 21st Century (TEA-21). The Act recognizes the importance of standards as essential to the deployment of integrated intelligent transportation systems (ITS) that benefit the National transportation system.

We expect that more than 100 consensus private-sector standards will be developed for ITS applications. These standards will enable the use of new technologies to provide ITS services for improvements in surface transportation systems in such areas as traffic management, transit operations, traveler information, emergency vehicle priority and commercial vehicle operations. The standards will yield improved safety, greater efficiency, and reduced costs to users of our highway systems. They are based upon the National ITS Architecture that the Department developed in partnership with public agencies and suppliers of transportation products and services.

TEA-21 requires us to identify which standards are critical to ensuring national interoperability or critical to the development of other standards. This report identifies those critical standards. However, it does not address many other equally important ITS standards, such as standards that are important for public infrastructure, transit, or safety which the Department is also committed to seeing developed.

A National consensus among ITS stakeholders supports the position we have taken in this report. Consensus grew out of a variety of dialogues, including discussions at meetings, evaluation of public comments resulting from a Federal Register notice, a two-day public workshop, and consultations of an ad-hoc advisory group, all coordinated by the Intelligent Transportation Society of America.

Rodney E. Slater

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## INTRODUCTION

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Intelligent Transportation Systems (ITS) standards are industry-consensus standards that provide the details about how different systems interconnect and communicate information to deliver the ITS user services described in the National ITS Architecture. These standards are intended to meet specific communications needs for ITS. They provide for consistent messages and specify the information elements that make up those messages. Some of them address communications protocols or define how existing, more general standards should be applied to ITS services.

The Transportation Equity Act for the 21<sup>st</sup> Century (TEA-21) states, in Section 5205(a)(2)(c), that the primary goal of the ITS Standards Program is “*to promote and ensure interoperability in the implementation of intelligent transportation system technologies, including actions taken to establish critical standards.*” The Act requires the Secretary of Transportation to identify by June 1, 1999 “*which standards are critical to ensuring national interoperability or critical to the development of other standards and specifying the status of the development of each standard identified.*”

It is recognized that in order to achieve national interoperability both *technical* and *institutional* requirements must be satisfied. Standards address the *technical* requirements (in providing the details of how different components of an ITS interconnect and communicate), not the *institutional* requirements (e.g., government entities *agreeing* to exchange information and establishing conditions for this operational arrangement). ITS standards alone will not ensure complete interoperability. Institutional issues must also be addressed. Institutional issues are being addressed under other ITS program and policy initiatives within the US DOT, but are not addressed specifically in this report.

### **1. The meaning of “critical.”**

Standards designated as “critical” under the criteria of TEA-21 represent the two types of ITS standards cited by Congress for special attention. They are standards needed for national interoperability of ITS systems and standards needed to develop other national interoperability standards. For simplicity, we call these *national* standards and *foundation* standards, respectively.

It is recognized that other ITS standards are equally important as those identified as critical. For example, there are other standards important for public transit, commercial vehicle operations, or for vehicle safety. The National Transportation Communications for ITS Protocol (NTCIP) standard for data communications, as a more specific example, may not be necessary for national interoperability. If, however, this standard is not completed and used, for example, then system operators will continue to be faced by limitations of interchangeability for equipment and local interoperability among systems.

## ***2. The process for choosing the critical standards***

Currently, about 80 ITS standards are being developed. Some of these are completed. It is expected that a total of over 100 standards will ultimately be developed to meet new and planned ITS services. To determine which of these standards are critical, a deliberate process was used.

The first step in the process was to define the “critical” aspects of national interoperability. This required examining system interfaces of ITS to determine if national interoperability can be achieved without requiring standardization.

From this understanding of national interoperability and the definition of critical, specific and measurable criteria were developed. The critical criteria were then compared to the National ITS Architecture and the affected interfaces among ITS systems were identified. The complete list of ITS standards, currently being developed, was then compared to each of the information flows across these interfaces. The final step in the process was selecting standards that corresponded to the critical information flows identified in the National ITS Architecture.

## ***3. Considerations in applying the critical criteria***

Although the process for selecting critical standards was designed to be methodical and rigorous, some judgement and interpretation were necessarily involved. Industry consensus standards are highly related to the needs and the availability of current technologies. For this and other reasons, some information flows are not addressed by current or planned standards development activities.

It is recognized that there will be future standardization efforts critical to national interoperability (e.g., highway-rail intersection and archive data user services). These items have not been included as part of the critical list but are recognized as efforts to be facilitated by the US DOT ITS standards program when appropriate.

Certain information flows represent very specialized services that do not yet exist, such as information exchanges relating to at-grade highway-rail crossings. Although some of these specialized information flows are included in current or planned standards projects, some of them may not be easily subject to standardization, or may be better left to competition in the marketplace.

The following section describes the development and application of the critical criteria.

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## CRITERIA FOR CRITICAL STANDARDS

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### ***1. Standards that ensure national interoperability***

Under the National ITS Architecture, it is essential that ITS systems have the ability to communicate and share information within and across geographic and jurisdictional boundaries. ITS systems require interoperability in the sense of being able to exchange and share information freely. However, as technical standards for information exchange, the standards identified in this report are necessary, but not sufficient, by themselves, for the intended interoperability of ITS systems. At least two additional ingredients are needed to achieve complete interoperability among systems.

The first is a series of performance measures that define expected quality characteristics for data, devices, and systems. While the general need for such performance measures is clear, the ITS industry is in too early a stage of development and testing to be able to define or create them at present. Performance measures such as speed, accuracy, and reliability will be an important focus area in future years as real-world experience with ITS products and services grows. Real-world experience will undoubtedly also result in further refinement of the information exchange standards addressed in this report.

The second needed ingredient, even with all relevant technical standards in place, is resolution of a variety of institutional issues that will assure the administrative interoperability of ITS services. For example, imagine that all electronic toll collection activities used identical technology. Even so, a motorist could not use a toll tag issued by one agency to pay tolls to another agency unless the agencies agreed to serve as each other's collection agents and to transfer funds to one another. These administrative issues are beyond the scope of ITS standards development.

A single standardized interface to ensure national interoperability is needed for those systems that must be accessed nation-wide by a large number of individual users, such as mobile users communicating from vehicles and personal communications devices. Fixed ITS systems that communicate with a limited number of other systems can be built to communicate with each of these other systems, even if they have different interfaces. However, systems that must access or be accessed by a large

number of other systems cannot be easily adapted to communicate with these different systems if they have different communications interfaces. For example, when travelers make their way across multiple geographical or jurisdictional regions, their vehicles or hand-held devices cannot readily be modified “on the fly” to access different ITS systems along the way. In contrast, standardization facilitates continuous ITS services and functionality through such in-vehicle or hand-held mobile devices.

Although it is critical that ITS systems that interface with and provide services to large numbers of other systems be standardized to interoperate nationally, only the interfaces between systems must be standardized. That is, only the communications interfaces between multiple-user ITS systems and the multiple-user systems themselves must be standardized, not their specific designs. This would apply, for example, to the interfaces between roadside devices and vehicular or hand-held devices.

Multiple-user systems where large numbers of users across the Nation access ITS services include commercial vehicle information systems and mobile-user systems. Commercial vehicle systems require each of thousands of commercial vehicle operations to access one or more, sometimes many, different state transportation agency systems and databases. A single standardized interface that allows national interoperability is the only manageable solution to enable interoperability for information exchange for such necessary functions as safety assurance and regulatory compliance.

A second situation where standardization on a nation-wide basis is essential is access to ITS systems by mobile users. Mobile-user ITS systems fall into two broad categories: traveler information systems and vehicle-infrastructure communications. The following two examples illustrate the concept:

1. Private automobiles and other mobile users readily access desired traveler information wherever it is available as they travel across the Nation.
2. Commercial vehicles electronically send identification information that results in the recording of taxes or the relaying of inspection information in any state.

Critical standards that ensure national interoperability meet the criterion that they are **standards that ensure national interoperability in those circumstances where large numbers of users, particularly mobile users, must access available ITS**

**services.** Such critical standards are designated “national” standards.

## ***2. Standards needed for the development of other standards***

Standards that are “needed for the development of other standards” are deemed critical if they meet the criterion that they are **standards that are needed for the development of other critical standards**. These are “foundation” standards. They are standards that are prerequisites to “national” standards or to other foundation standards. They are used in the process of developing other critical standards or are used by or incorporated into other critical standards.

Foundation standards include, for example, data dictionary standards, which define the data element requirements for ITS functional areas and which are used in critical message standards. Standards that are needed for the development of data dictionary standards are also foundation standards. Another example of a foundation standard is the location-referencing standard used in national standards for various ITS services.



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## LIST OF TEA-21 CRITICAL STANDARDS

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The following is a list of the ITS standards that meet the criteria for criticality described above. These standards either: (1) ensure that large numbers of users, particularly mobile users, can readily access available ITS services anywhere in the Nation (identified as “national”), or (2) are required by other critical standards (identified as “foundation”).

The list is ordered alphabetically by the name of the standard. Provided for each standard is the name of the lead standards development organization (SDO), the SDO document number, a brief description, the type of criticality, the rationale for criticality under TEA-21, and the current status. Standards whose status is “under development” are in pre-ballot review by relevant standards committees. “In ballot” standards are currently being balloted by the standards committees of the SDOs, or have passed committee ballot and are being balloted at a higher level within the SDOs. “Approved” standards have passed ballot in their respective SDO and are awaiting actual publication. “Published” standards are available for purchase from the publishing SDO. While all critical standards listed are not currently available from the SDOs, it is anticipated that they will be available well before January 1, 2001. This is the date at which TEA-21 authorizes the US DOT Secretary to establish a “provisional” standard for any identified critical standard that cannot be developed or approved by the responsible SDO. Six months before the January 1, 2001 date, the Department will complete and publish an assessment of ITS critical standards to determine if provisional standards are necessary.

The information in the list that follows reflects the status of the standards as of May 20, 1999.

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| <b>Name:</b>        | <b>Advanced Traveler Information System (ATIS)<br/>Data Dictionary</b>  |
| <b>SDO:</b>         | Society of Automotive Engineers   |
| <b>Document:</b>    | J2353   |
| <b>Description:</b> | A minimum set of media-independent data elements needed by potential information service providers to deploy ATIS services and provide the basis for future interoperability of ATIS devices. |
| <b>Criticality:</b> | Foundation  |
| <b>Rationale:</b>   | Enables service providers with conforming products to provide travel information to mobile users nationally.  |
| <b>Status:</b>      | In ballot   |

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| <b>Name:</b>        | <b>Advanced Traveler Information System (ATIS)<br/>Message Set</b>  |
| <b>SDO:</b>         | Society of Automotive Engineers   |
| <b>Document:</b>    | J2354   |
| <b>Description:</b> | A basic message set, using the data elements from the ATIS Data Dictionary standard, needed by potential information service providers to deploy ATIS services and provide the basis for future interoperability of ATIS devices. |
| <b>Criticality:</b> | National  |
| <b>Rationale:</b>   | Enables service providers with conforming products to provide travel information to mobile users nationally.  |
| <b>Status:</b>      | In ballot   |

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| <b>Name:</b>        | <b>Advanced Traffic Management Systems (ATMS)<br/>Data Dictionary (TMDD)</b>   |
| <b>SDO:</b>         | Institute of Transportation Engineers  |
| <b>Document:</b>    | TM 1.03  |
| <b>Description:</b> | A data dictionary for traffic management applications. Describes and standardizes roadway links and nodes (that is, location information) for incidents and traffic-disrupting roadway events. Includes data elements for traffic control, traffic detectors, actuated signal controllers, traffic modeling, vehicle probes, ramp metering data, dynamic message signs (DMS), video and camera control, parking management and weather stations. |
| <b>Criticality:</b> | Foundation   |
| <b>Rationale:</b>   | The Advanced Traffic Management System (ATMS) data dictionary is used by traveler information systems that provide services to mobile users nationally, such as information about roadway conditions, and by traffic management systems that collect, interpret and present traffic management information.  |
| <b>Status:</b>      | In ballot  |

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| <b>Name:</b>        | <b>Commercial Vehicle Credentials</b>  |
| <b>SDO:</b>         | American National Standards Institute, Accredited Standards Committee X12, Electronic Data Interchange   |
| <b>Document:</b>    | TS 286   |
| <b>Description:</b> | A set of transactions for electronic data interchange that can be used by owners, lessees, and drivers of commercial motor vehicles to apply electronically for credentials necessary to operate those vehicles legally, and by authorizing jurisdictions to transmit electronically credential data to applicants and other authorized parties. |
| <b>Criticality:</b> | National   |
| <b>Rationale:</b>   | Enables every commercial carrier to communicate with and transmit required information to state transportation agencies and relevant state and national databases electronically.  |
| <b>Status:</b>      | Published  |

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| <b>Name:</b>        | <b>Commercial Vehicle Safety and Credentials Information Exchange</b>   |
| <b>SDO:</b>         | American National Standards Institute, Accredited Standards Committee X12, Electronic Data Interchange  |
| <b>Document:</b>    | TS 285  |
| <b>Description:</b> | A set of transactions for electronic data interchange that permits enforcement officials, government administrators and other authorized parties to ask electronically for information on the safety performance, regulatory compliance and credentials status of commercial motor vehicles, carriers and drivers. Can also be used by the sources that maintain such data to respond electronically to the requests. |
| <b>Criticality:</b> | National  |
| <b>Rationale:</b>   | Enables every commercial carrier to communicate with and transmit required information to state transportation agencies and relevant state and national databases electronically.   |
| <b>Status:</b>      | Published   |

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| <b>Name:</b>        | <b>Commercial Vehicle Safety Reports</b>  |
| <b>SDO:</b>         | American National Standards Institute, Accredited Standards Committee X12, Electronic Data Interchange  |
| <b>Document:</b>    | TS 284  |
| <b>Description:</b> | A set of transactions for electronic data interchange that allows authorized parties to request and send electronically reports on information related to the safe operation of commercial vehicles, such as inspection reports, safety and compliance review reports, and hazardous material incident reports. |
| <b>Criticality:</b> | National  |
| <b>Rationale:</b>   | Enables every commercial carrier to communicate with and transmit required information to state transportation agencies and relevant state and national databases electronically.   |
| <b>Status:</b>      | Published   |

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| <b>Name:</b>        | <b>High Speed FM Subcarrier Waveform Standard</b>  |
| <b>SDO:</b>         | Electronics Industry Alliance/Consumer Electronics Manufacturers Association   |
| <b>Document:</b>    | To be determined   |
| <b>Description:</b> | A high speed FM subcarrier signaling system using a data radio channel modulation scheme for wide-area data transfer for multiple applications, including traffic data for travelers and vehicles. |
| <b>Criticality:</b> | National   |
| <b>Rationale:</b>   | Allows traveler information messages to be broadcast to travelers nationally.  |
| <b>Status:</b>      | Currently two competing standards have been approved.  |

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| <b>Name:</b>        | <b>Information Service Provider-Vehicle Location Referencing Standard</b>  |
| <b>SDO:</b>         | Society of Automotive Engineers  |
| <b>Document:</b>    | J1746  |
| <b>Description:</b> | A standard location-referencing format for information service provider (ISP)-to-vehicle and vehicle-to-ISP references. This standard adopts the cross-streets profile of the current location reference message specification (LRMS) document as expressed in SAE's National Location Referencing Information Report (J2374). |
| <b>Criticality:</b> | National and Foundation  |
| <b>Rationale:</b>   | Assures consistency in location referencing and uniform processing for mobile users nationally; used in other standards that specify location information.   |
| <b>Status:</b>      | Under development  |

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| <b>Name:</b>        | <b>Message Sets for DSRC, ETTM and CVO</b>  |
| <b>SDO:</b>         | Institute of Electrical and Electronics Engineers   |
| <b>Document:</b>    | P1455   |
| <b>Description:</b> | Prescribes standard messages for dedicated short range communications (DSRC), and electronic toll and traffic management (ETTM) applications and commercial vehicle operations (CVO). |
| <b>Criticality:</b> | National  |
| <b>Rationale:</b>   | Provides message sets for various ITS user services, such as electronic toll, traffic management, and commercial vehicle operations.  |
| <b>Status:</b>      | In ballot   |

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| <b>Name:</b>        | <b>On-Board Land Vehicle Mayday Reporting Interface</b>  |
| <b>SDO:</b>         | Society of Automotive Engineers  |
| <b>Document:</b>    | J2313  |
| <b>Description:</b> | Prescribes techniques that enable vendors with different communication methods to communicate with emergency response agencies in a standard digital format. |
| <b>Criticality:</b> | National   |
| <b>Rationale:</b>   | Provides for the transmission of messages and information between emergency management centers and mobile users nationally.                                  |
| <b>Status:</b>      | Approved   |

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| <b>Name:</b>        | <b>Standard for Common Incident Management Message Sets for Use by Emergency Management Centers</b>  |
| <b>SDO:</b>         | Institute of Electrical and Electronics Engineers  |
| <b>Document:</b>    | P1512  |
| <b>Description:</b> | Standardizes the form and content of incident management messages and provides an emergency management data dictionary for use by all participating centers, including traffic management centers, public safety dispatch centers, hazardous material response centers, emergency management centers, emergency medical services, MAYDAY processing centers, and incident command posts. |
| <b>Criticality:</b> | Foundation   |
| <b>Rationale:</b>   | Allows incident management messages to be shared among different ITS systems and entities and assures consistency of incident management messages.   |
| <b>Status:</b>      | Under development  |

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| <b>Name:</b>        | <b>Standard for Data Dictionaries for Intelligent Transportation Systems</b>  |
| <b>SDO:</b>         | Institute of Electrical and Electronics Engineers   |
| <b>Document:</b>    | P1489   |
| <b>Description:</b> | Provides a standard structure for describing entries and attributes of data elements used in all ITS data dictionary standards and provides common structures, conventions and models that enable describing, standardizing, and managing all ITS data. |
| <b>Criticality:</b> | Foundation  |
| <b>Rationale:</b>   | Establishes the requirements for the attributes to be used by all ITS data dictionary standards to assure unambiguous information transfer.   |
| <b>Status:</b>      | In ballot   |

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| <b>Name:</b>        | <b>Standard for Message Set Template for ITS</b>   |
| <b>SDO:</b>         | Institute of Electrical and Electronics Engineers  |
| <b>Document:</b>    | P1488  |
| <b>Description:</b> | Describes the structure of message sets for data exchange between traffic centers, emergency management centers and traveler information systems in a consistent and uniform manner. |
| <b>Criticality:</b> | Foundation   |
| <b>Rationale:</b>   | Standardizes the structure for messages used in all ITS standards.   |
| <b>Status:</b>      | Under development  |

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**Name:**           **Standard Specification on Dedicated Short Range Communications (DSRC)—Data Link Layer**

**SDO:**            American Society for Testing & Materials

**Document:**     ASTM 1 (temporary)

**Description:**   Specification for the data link protocol for dedicated short-range communications for ITS applications, such as electronic toll payment and commercial vehicle electronic screening.

**Criticality:**     National

**Rationale:**     Allows for short-range communications between roadside equipment and vehicles nationally.

**Status:**         In ballot

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**Name:**           **Standard Specification on Dedicated Short Range Communications (DSRC)—Physical Layer**

**SDO:**            American Society for Testing & Materials

**Document:**     PS 111-98

**Description:**   Specification for the radio-frequency characteristics for dedicated short-range communications operating in the 902-928 MHz frequency band. Supports both active and backscatter technologies.

**Criticality:**     National

**Rationale:**     Allows for short-range communications between roadside equipment and vehicles nationally.

**Status:**         Approved

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**Name:**           **Standard Specification on Dedicated Short Range Communications (DSRC) at 5.89 GHz**

**SDO:**            To be determined

**Document:**    To be determined

**Description:**   Proposed specification for the radio-frequency characteristics for dedicated short-range communications operating at a frequency of 5.89 GHz. (This is the international frequency for ITS applications. It is under consideration by the Federal Communications Commission for use in the United States for future ITS applications.)

**Criticality:**     National

**Rationale:**     Allows for short-range communications between roadside equipment and vehicles nationally.

**Status:**         Under development

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**Name:**           **Standards for ATIS Message Sets Delivered Over Bandwidth Restricted Media**

**SDO:**            Society of Automotive Engineers

**Document:**    J2369

**Description:**    A general framework allowing transmission of traveler information via bandwidth-reduced media such as those found in wireless applications. Creates a uniform coding and message structure for link travel times, incident text, and weather and transit information for broadcast delivery.

**Criticality:**     National

**Rationale:**     Allows mobile users with conforming products to access traveler information services uniformly nationally.

**Status:**         In ballot

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## Other Considerations for National Interoperability

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Congress' intent in the Intelligent Systems Act of 1998 (Title V, subtitle C of TEA-21) was to provide for complete interoperability rather than just technical interoperability. As stated earlier, technical standards are often necessary but not sufficient to achieve *complete* interoperability. This is particularly true in the ITS program for commercial vehicles --i.e., Commercial Vehicle Information Systems and Networks (CVISN)--where national interoperability is considered by the US DOT, states, and by industry to be crucial. Beyond the technical standards associated with various interfaces of the CVISN architecture, procedures to ensure interoperability among the states are critical to national interoperability. Such procedures do not currently exist but have been proposed by the Intelligent Transportation Society of America (ITS America) and the American Association of State Highway and Transportation Officials (AASHTO).